

What is HexSim?

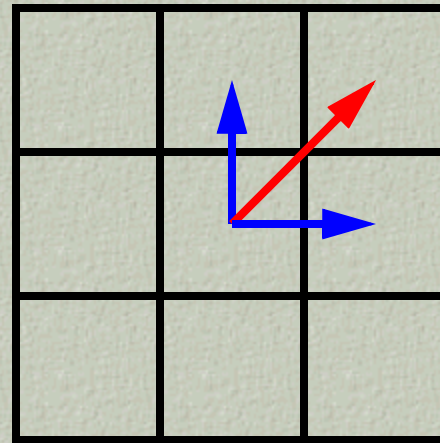
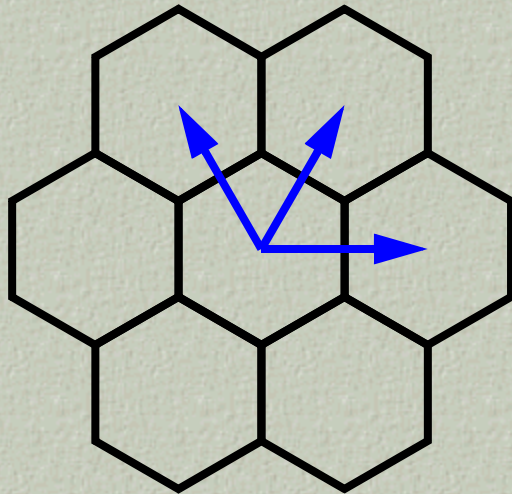
- ➔ It is a computer simulation model.
- ➔ It is useful for evaluating wildlife population responses to human activities.
- ➔ It is modern and sophisticated, but flexible and easy to use.
- ➔ It can be used with a large range of places, problems, and questions.

How is HexSim Different?

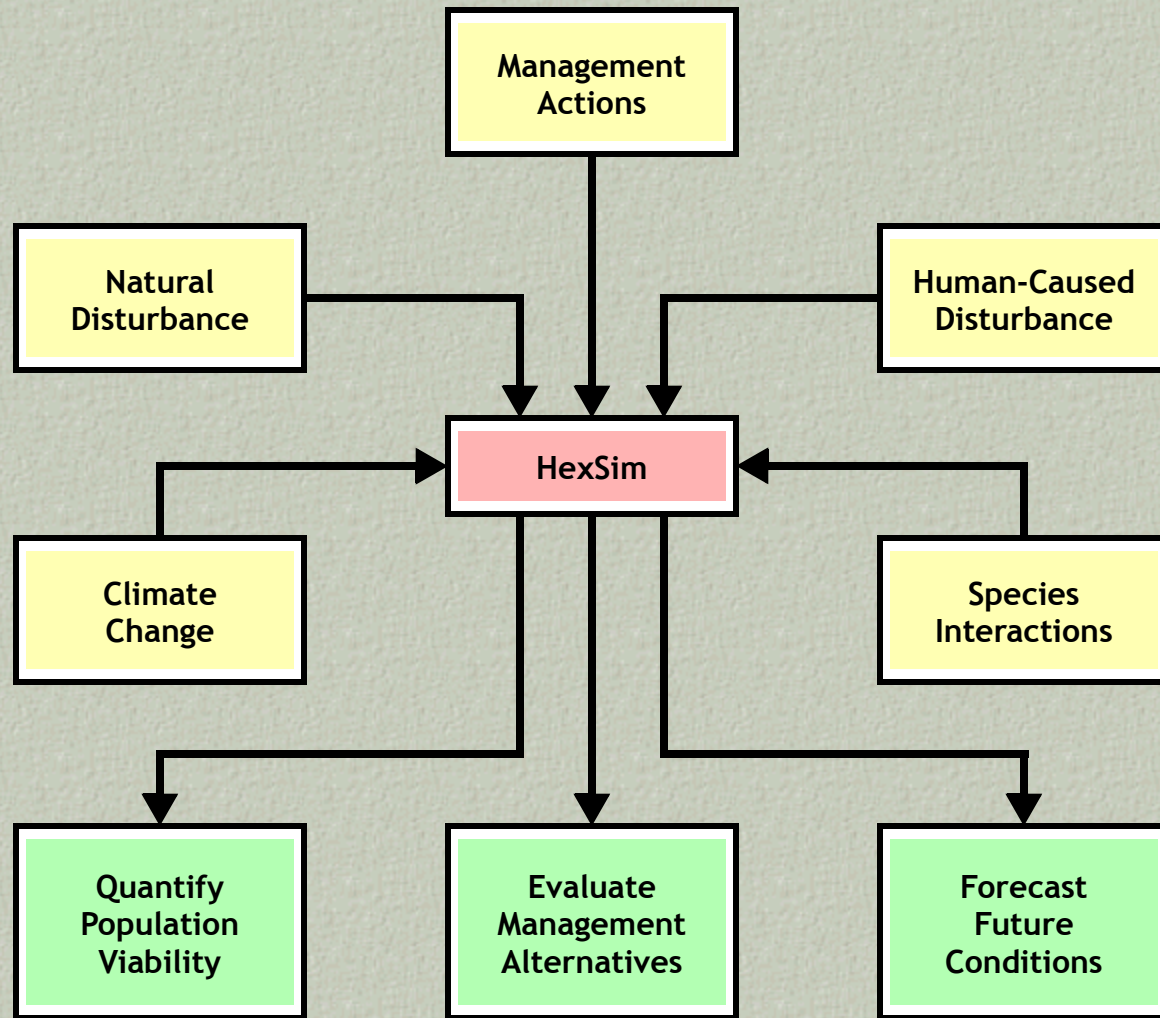
- ➔ It has a wide range of potential applications.
- ➔ It contains no simplifying assumptions about the biology or ecology of the study systems
- ➔ Every individual can have unique properties that change throughout their lifetimes
- ➔ Can simulate population interactions, stressor interactions, landscape genetics, and more
- ➔ Modern and easy to use, with graphical user interfaces (GUI) for every model component

Why Hexagons?

- They provide a space-filling tessellation
- Each of a hexagon's neighbors is the same distance away.



What Can HexSim Do?



Life History Events

- ➔ Survival
- ➔ Reproduction
- ➔ Movement
- ➔ HexMap Generation
- ➔ Species Interaction
- ➔ Species Introduction
- ➔ Mutation
- ➔ And so on...

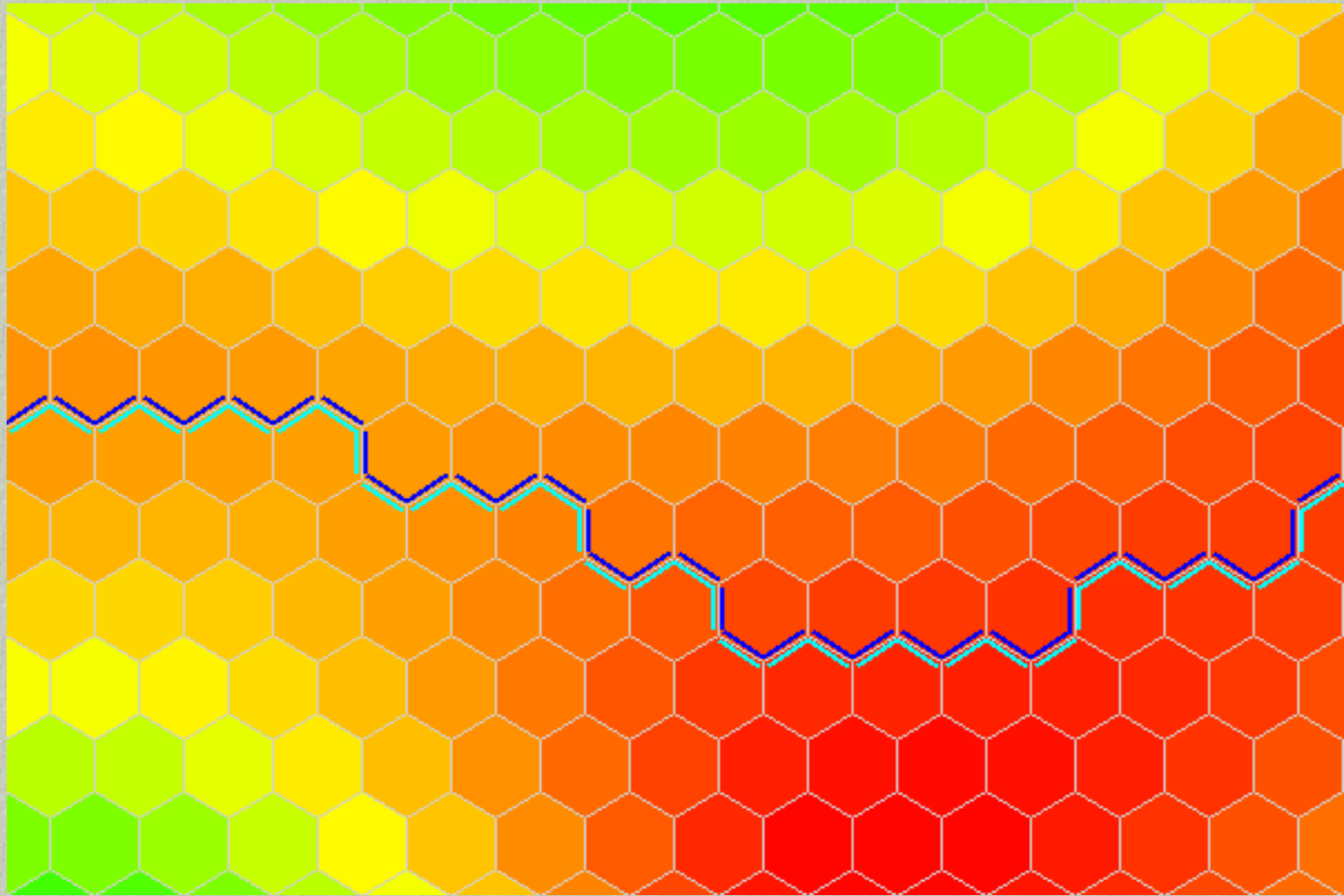
Trait Types

- ➔ Probabilistic Traits
- ➔ Accumulated Traits
- ➔ Heritable Traits

HexSim Features

- ➔ **Spatially-Explicit and Individual-Based**
- ➔ **Dynamic Landscape Change**
- ➔ **General and Flexible**
- ➔ **Multi-Stressor with Interactions**
- ➔ **Multi-Population with Interactions**
- ➔ **Females-only or 2-Sex Simulations**
- ➔ **Two Mate-Finding Sub-Models**
- ➔ **Life History Events Stratified by Traits**
- ➔ **Modern Interface**
- ➔ **Useful Outputs**

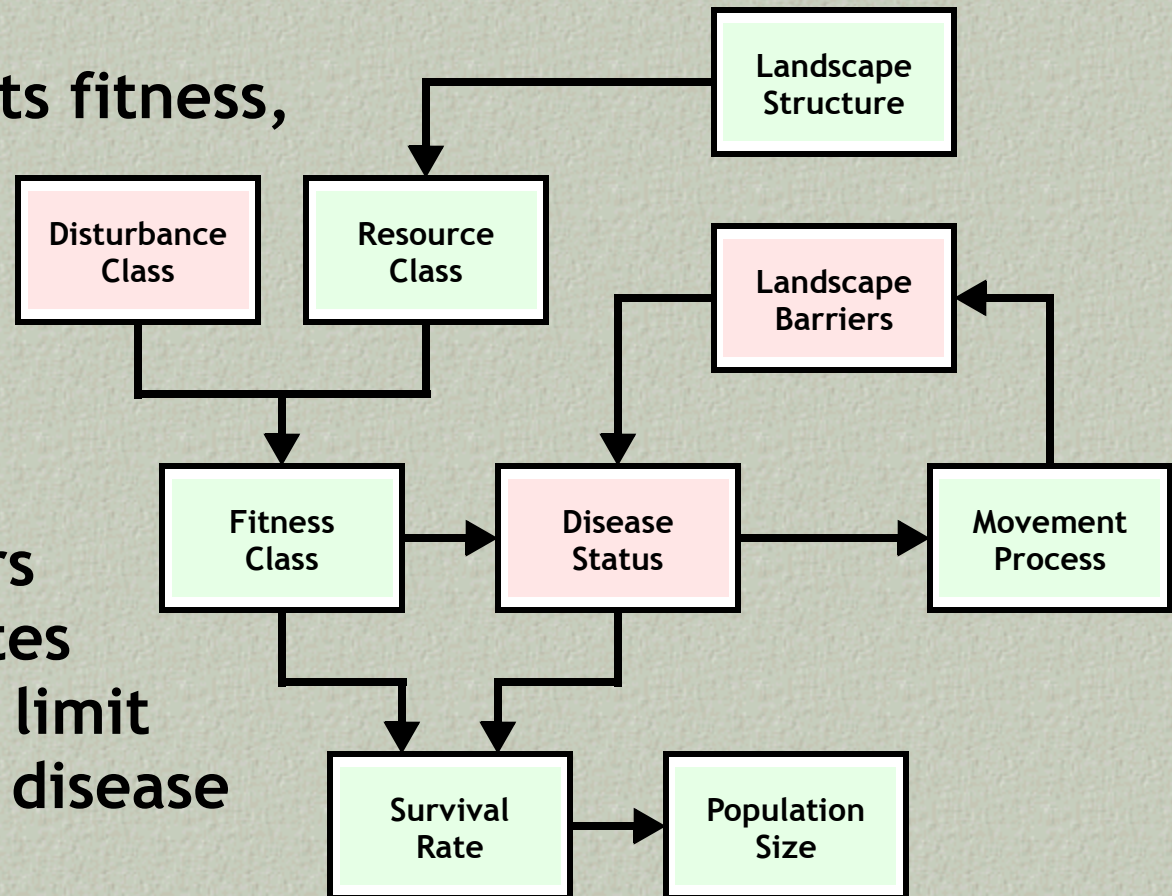
Movement Barriers



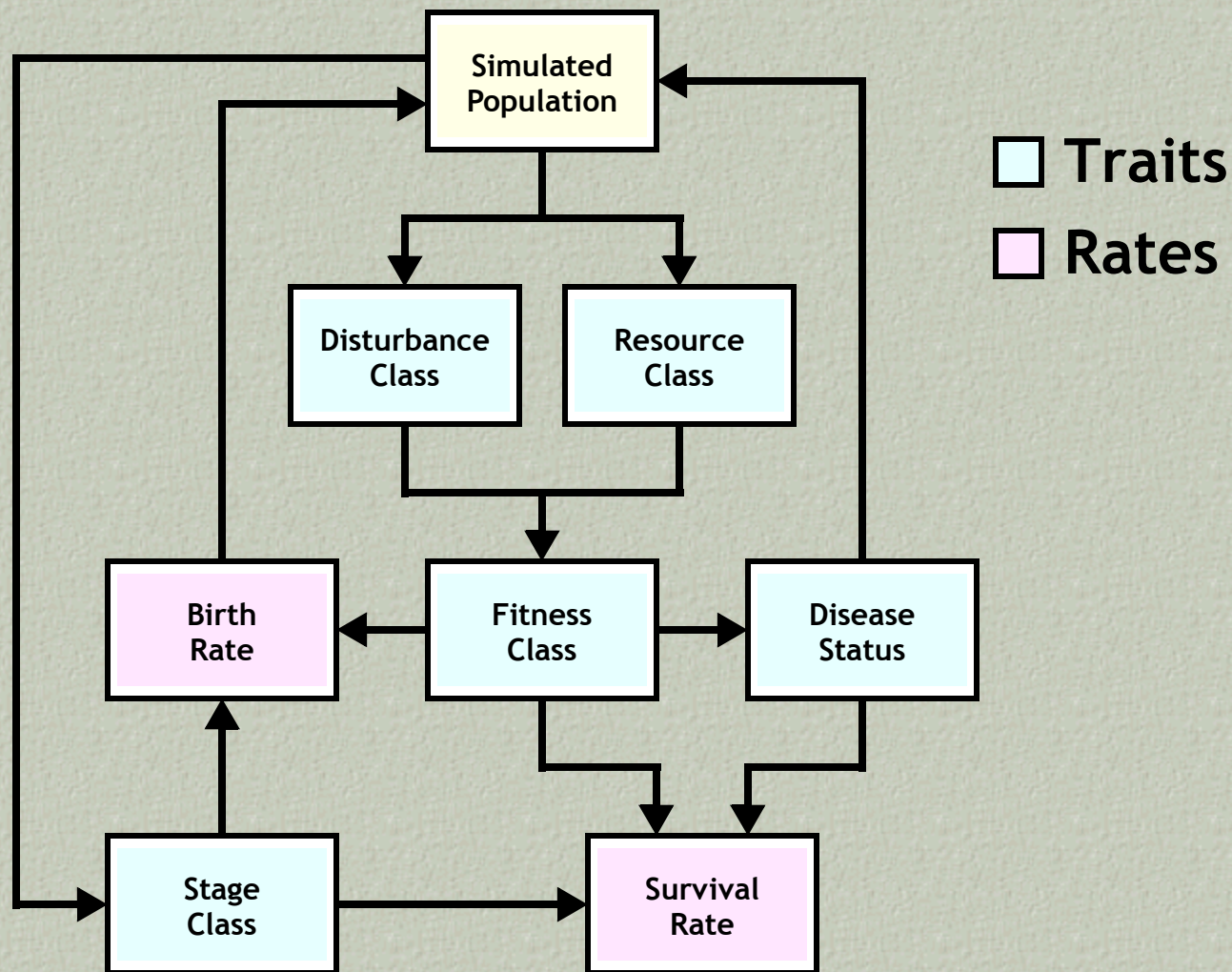
Hypothetical Example of a Moderate-Complexity Scenario

- Disturbance affects fitness, which in turn impacts disease status, survival, and reproduction

- Movement barriers affect survival rates because they can limit the spread of the disease



The Trait Structure Used in This Example



Example: Red-cockaded Woodpeckers

HexSim Version 1.6.0.13

HexSim Scenario About

Workspace RCW Life History X

Simulation Parameters

Number of Replicates 1

Time Steps / Replicate 500

Stochasticity Random

Populations

Females only

Spatial Data

Ft. Benning RCW Habitat

1
400
405
410
415
420
425
430
435
440

Event Sequence

Type	Name
Accumulate	Aging
Movement	Adults Only
Accumulate	
Survival	
Reproduction	
Floater Creation	
Movement	
Survival	
Accumulate	
Census	
Range Dynamics	

Ft. Benning RCW Habitat [1]

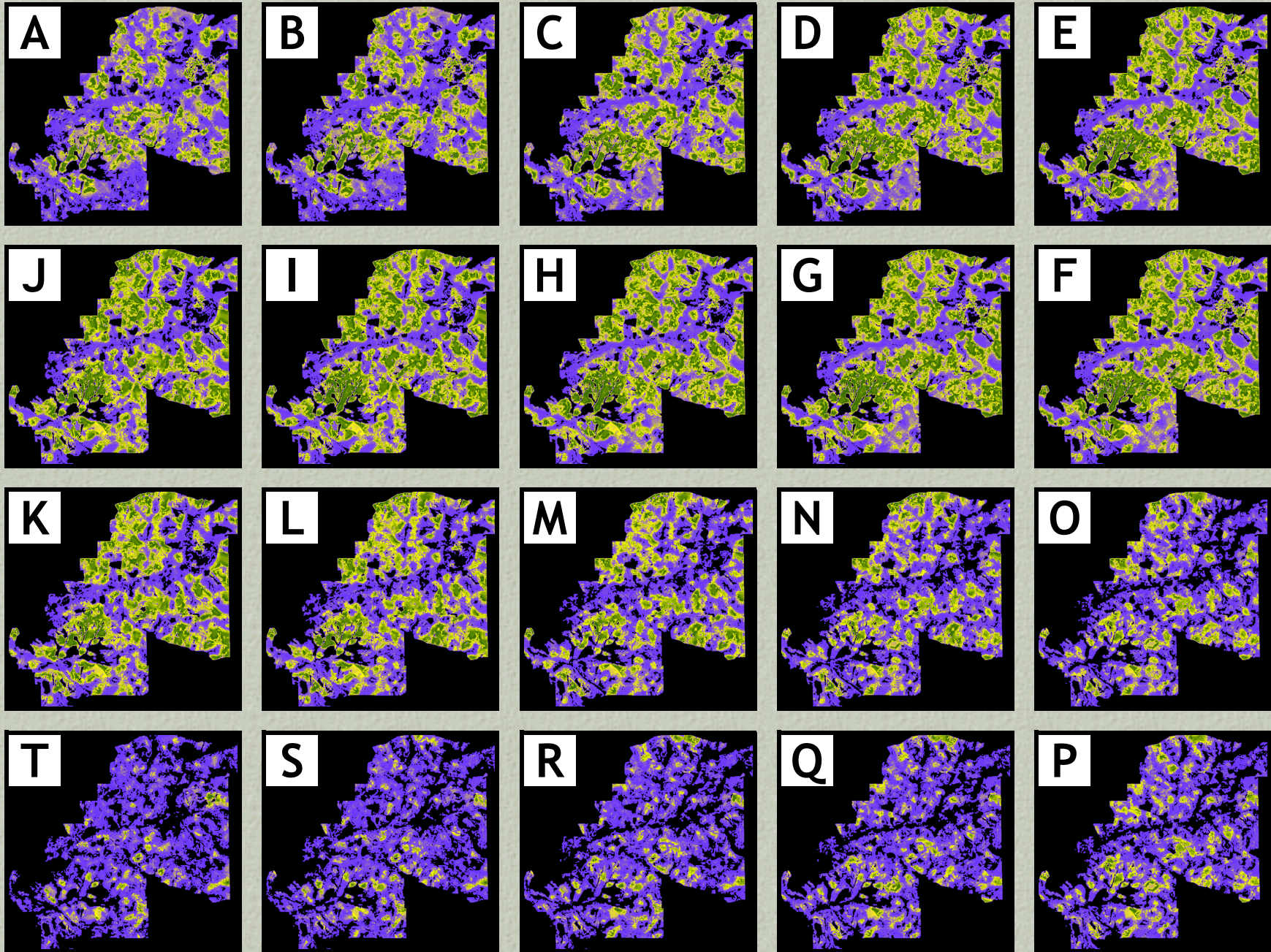
File View Edit

Rows 139-199 of 374 Cols 248-312 of 332 Scores: 0.0000 to 97.9232

Current Workspace is C:\Documents and Settings\Nathan\Desktop\Betsy's RCW\Worksp

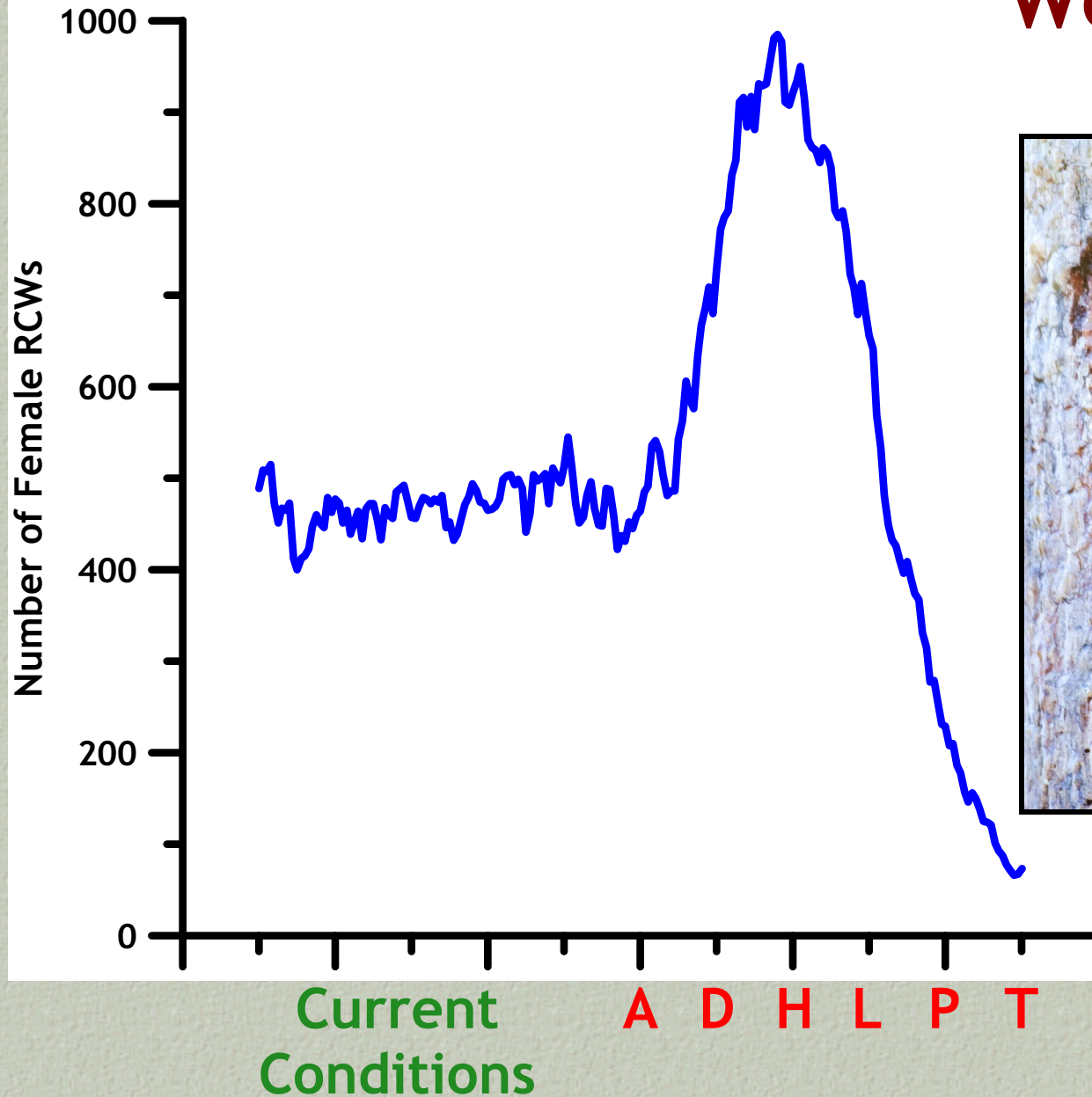
The screenshot displays the HexSim software interface. The main window is titled 'HexSim Version 1.6.0.13' and has a menu bar with 'HexSim', 'Scenario', and 'About'. Below the menu bar is a tabbed interface with 'Workspace' and 'RCW Life History'. The 'Workspace' tab is active, showing 'Simulation Parameters' (Number of Replicates: 1, Time Steps / Replicate: 500, Stochasticity: Random), 'Populations' (Females only), and 'Spatial Data' (Ft. Benning RCW Habitat). The 'RCW Life History' tab is also visible, showing an 'Event Sequence' table. A smaller window titled 'Ft. Benning RCW Habitat [1]' is open, displaying a spatial map of the habitat with a color-coded grid. The map shows a complex pattern of red, orange, yellow, and green hexagons, representing different habitat types or scores. The status bar at the bottom of the main window indicates the current workspace path: 'C:\Documents and Settings\Nathan\Desktop\Betsy's RCW\Worksp'.

Red-cockaded Woodpecker Habitat

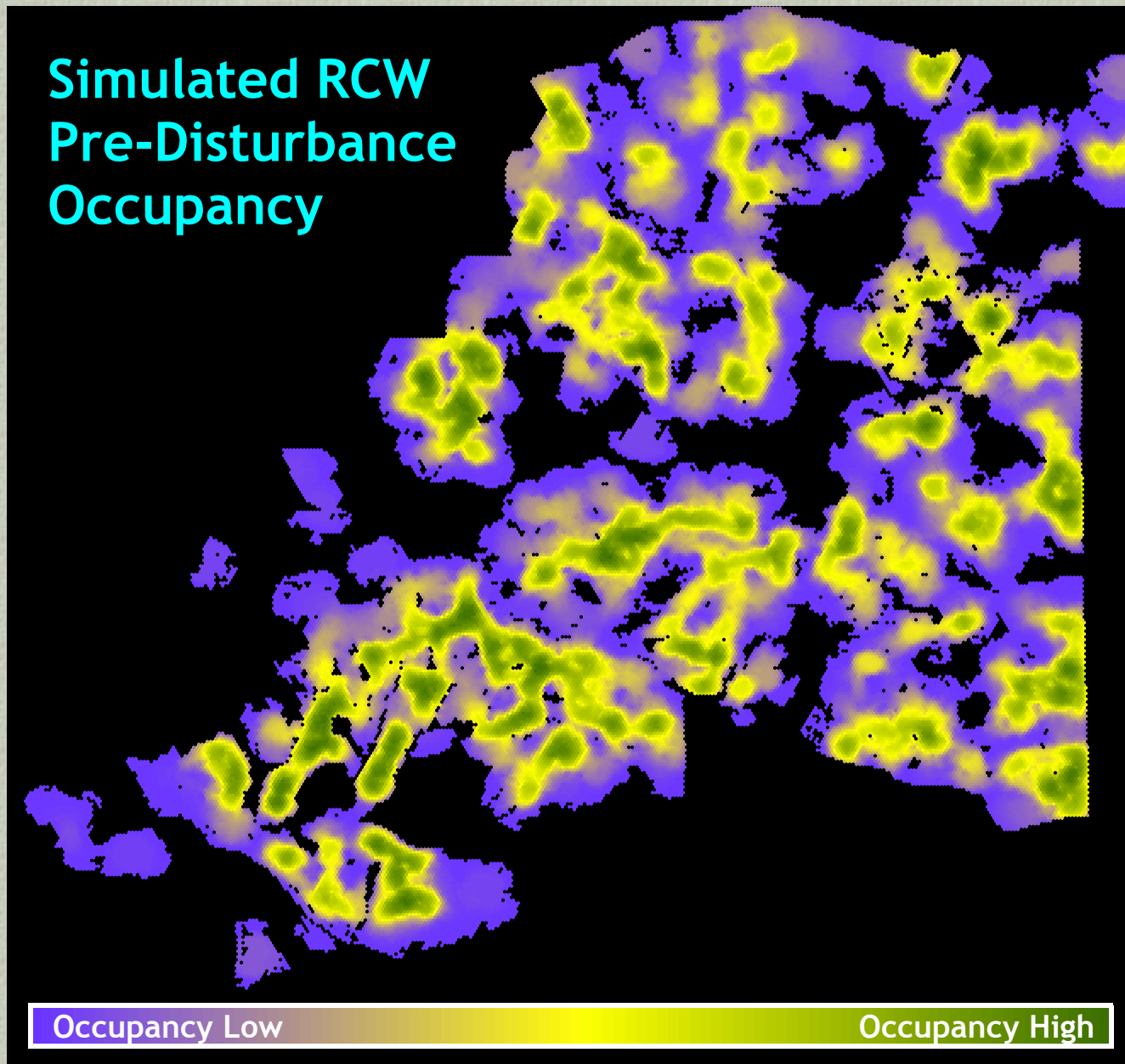


Population Response to Landscape Alteration

Red-cockaded Woodpecker Study



Simulated RCW
Pre-Disturbance
Occupancy

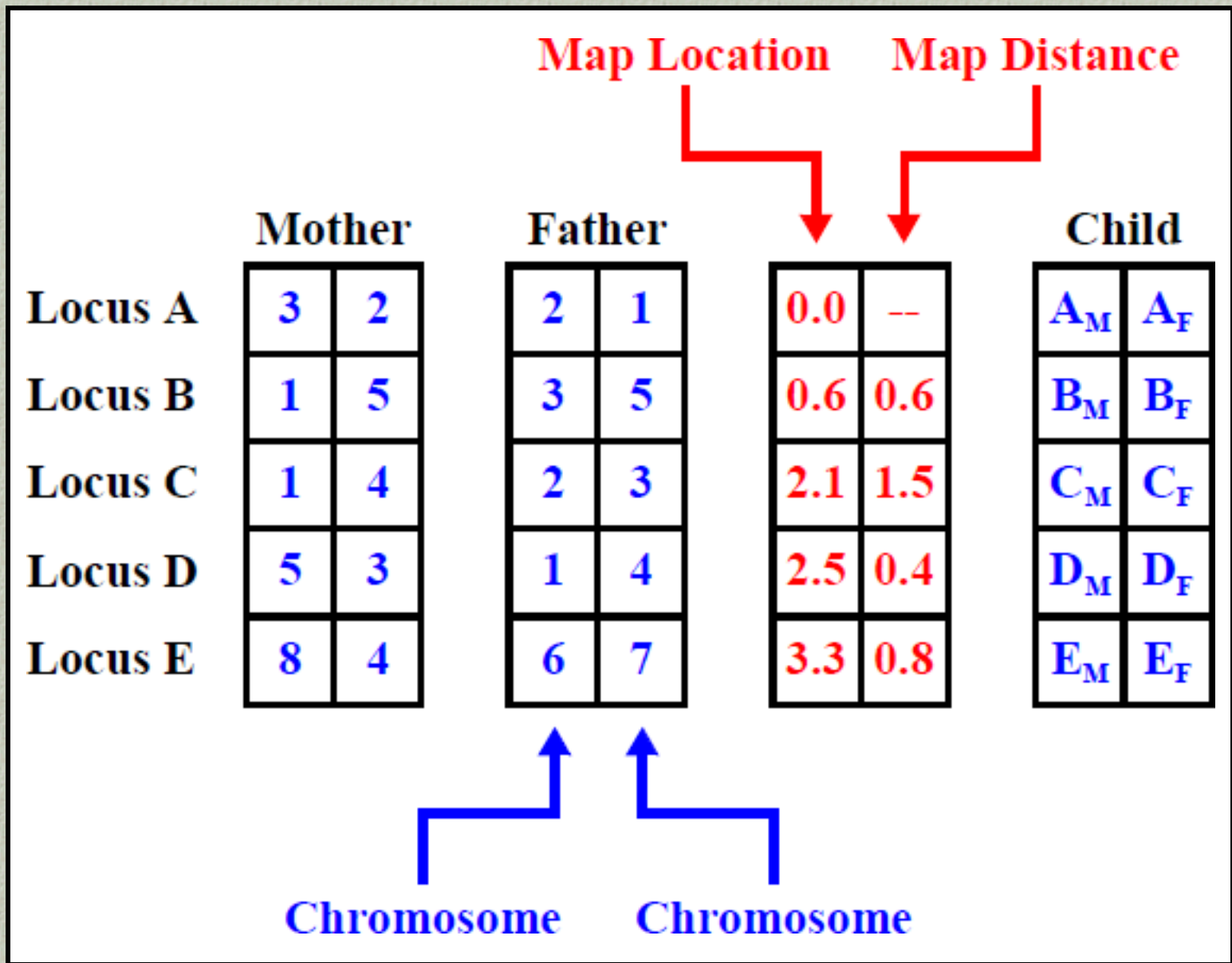


HexSim Genetics

- ➔ Each individual is assigned a genome
- ➔ Populations can have any number of loci
- ➔ Each locus can have any number of alleles
- ➔ Inheritance can be from mother, father, or from both parents (per locus)
- ➔ User-defined initial conditions, include spatial stratification of alleles

HexSim Genetics (cont.)

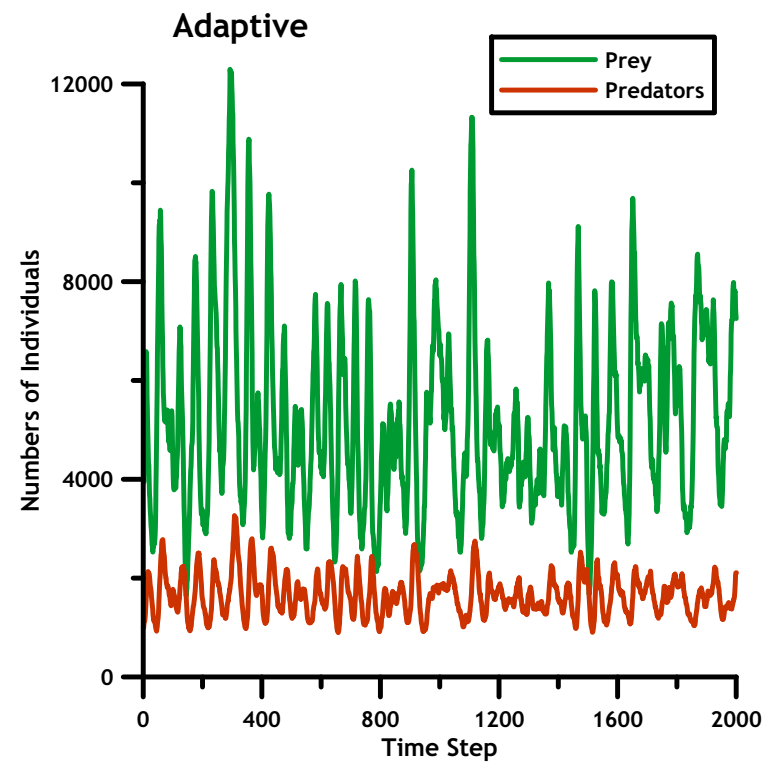
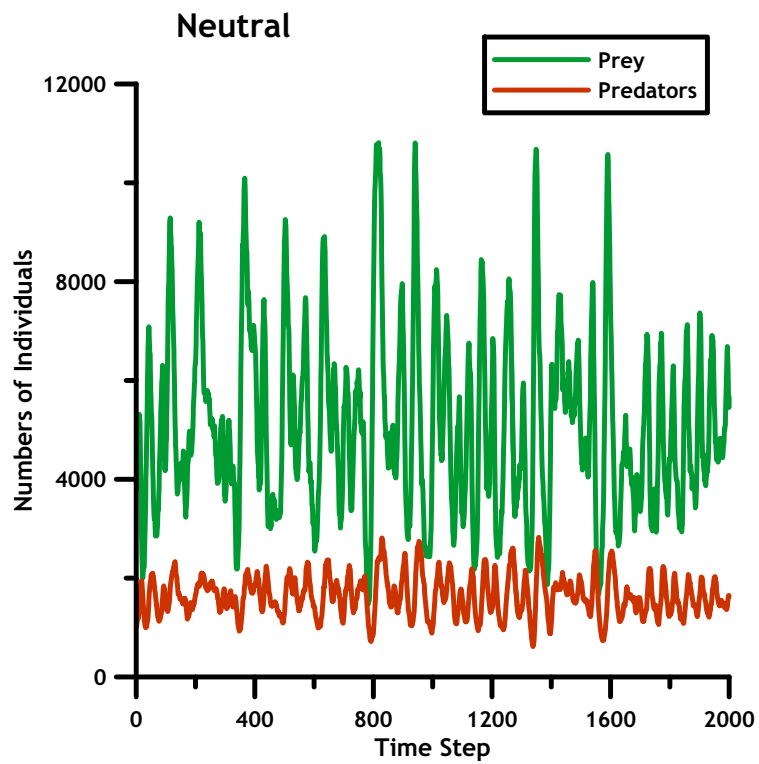
- ➔ Mutation events may be influenced by non-heritable traits (e.g. exposure)
- ➔ Heritable traits may be neutral or adaptive
- ➔ Heritable and other traits may be combined to influence life history events
- ➔ Map-distances may be used to simulate chromosome crossover



Example: Predators & Prey

- Two interacting populations**
- Predators & prey use different mating schemes**
- Prey live in colonies, predators do not**
- Predator males track prey
Predator females track males**
- Predator capture efficiency is controlled through a heritable trait.**
- Capture efficiency influences reproduction through a resource acquisition trait**
- Mutation alters capture efficiency trait**

Population Size



Allele Frequencies

